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and underlying Archean gneiss, central Baffin
Island, Nunavut**

D.J. Scott, M.R. St-Onge, and D. Corrigan

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Geology of the Paleoproterozoic Piling Group and underlying Archean gneiss, central Baffin Island, Nunavut

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Abstract: New mapping has refined the stratigraphic relationships within the Paleoproterozoic Piling Group (NTS 37 A, 27 B), as well as its relationship to underlying Archean basement orthogneiss of the Rae Craton. Across the project area, basal quartzite and rare psammite (Dewar Lakes Formation) are in tectonic contact with underlying orthogneiss, and are interpreted as a subsidence-related clastic sheet deposited on Rae basement. In the northern part of the area, carbonate units (Flint Lake Formation) overlie the quartzite, and are overlain by sulphidic pelite and iron-formation (Astarte River Formation), interpreted as a shelf that subsequently foundered. In the south, quartzite is overlain by mafic volcanic rocks and ultramafic to mafic sills interlayered with siliciclastic rocks (Bravo Lake Formation). Psammite/ pelite turbidites (Longstaff Bluff Formation) blanket the entire area, and are interpreted as an orogenic molasse that might have had a source area other than the Rae Craton. Deformation and consequent metamorphism occurred during the 1.8 Ga Trans-Hudson Orogeny.

Résumé : De nouveaux travaux de cartographie ont permis de mieux définir les relations stratigraphiques à l'intérieur du Groupe de Piling (SNRC 37A, 27B) du Paléoprotérozoïque ainsi que les liens de celui-ci avec les orthogneiss archéens du socle sous-jacent du craton de Rae. Dans toute la région du projet, un quartzite basal et de rares psammites (Formation de Dewar Lakes) reposent en contact tectonique sur les orthogneiss et représenteraient une nappe de roches sédimentaires clastiques associée à une subsidence qui se serait déposée sur le socle de Rae. Dans la partie nord de cette région, des unités de roches carbonatées (Formation de Flint Lake) surmontent le quartzite et sont elles-mêmes surmontées de pélites sulfurées et d'une formation de fer (Formation d'Astarte River); ces roches sédimentaires seraient les dépôts d'une plate-forme continentale qui s'est affaissée ultérieurement. Dans la partie sud, le quartzite est surmonté de roches volcaniques mafiques et d'une interstratification de filons-couches mafiques à ultramafiques et de roches silicoclastiques (Formation de Bravo Lakes). Des turbidites de pélite-psammite (Formation de Longstaff Bluff) s'étendent à l'ensemble de la région et représenteraient une molasse orogénique dont les matériaux pourraient provenir d'une source autre que le craton de Rae. La déformation et le métamorphisme associé remonterait à l'orogénèse transhudsonnienne (1,8 Ga).

INTRODUCTION

This report outlines preliminary field results from the 2001 season for the bedrock component of the Central Baffin Multidisciplinary Project, a collaborative effort of the Geological Survey of Canada, the Canada–Nunavut Geoscience Office, and the Polar Continental Shelf Project. Results for other components of the project, including Quaternary mapping, Barnes Ice Cap studies, 3-D structural modelling, teleseismic and magnetotelluric surveys, and gamma-ray spectrometry are reported separately.

The Central Baffin study area (Fig. 1) straddles the northern margin of the eastern segment of the ca. 1.8 Ga Trans-Hudson Orogen (Hoffman, 1988), a Himalayan-scale collisional mountain belt that is exposed from Greenland in

the east, across Baffin Island and beneath Hudson Bay, to Manitoba and Saskatchewan in the west. The northern part of the area is underlain by various orthogneisses, metamorphosed sedimentary and volcanic rocks of the Mary River Group, and younger felsic plutonic rocks, all of Archean age and ascribed to the Rae Craton (Jackson, 1969; Bethune and Scammell, 1997; Jackson, 2000; Corrigan et al., 2001). The central part of the study area is underlain by siliciclastic, carbonate, and mafic volcanic rocks of the Paleoproterozoic Piling Group (Morgan et al., 1975; 1976; Morgan, 1983; Henderson et al., 1989; Henderson and Henderson, 1994), described in further detail below. Various felsic plutonic rocks of the 1.86–1.85 Ga Cumberland batholith are exposed in the southern part of the area. Collectively, this assemblage of rocks is thought to represent a Paleoproterozoic

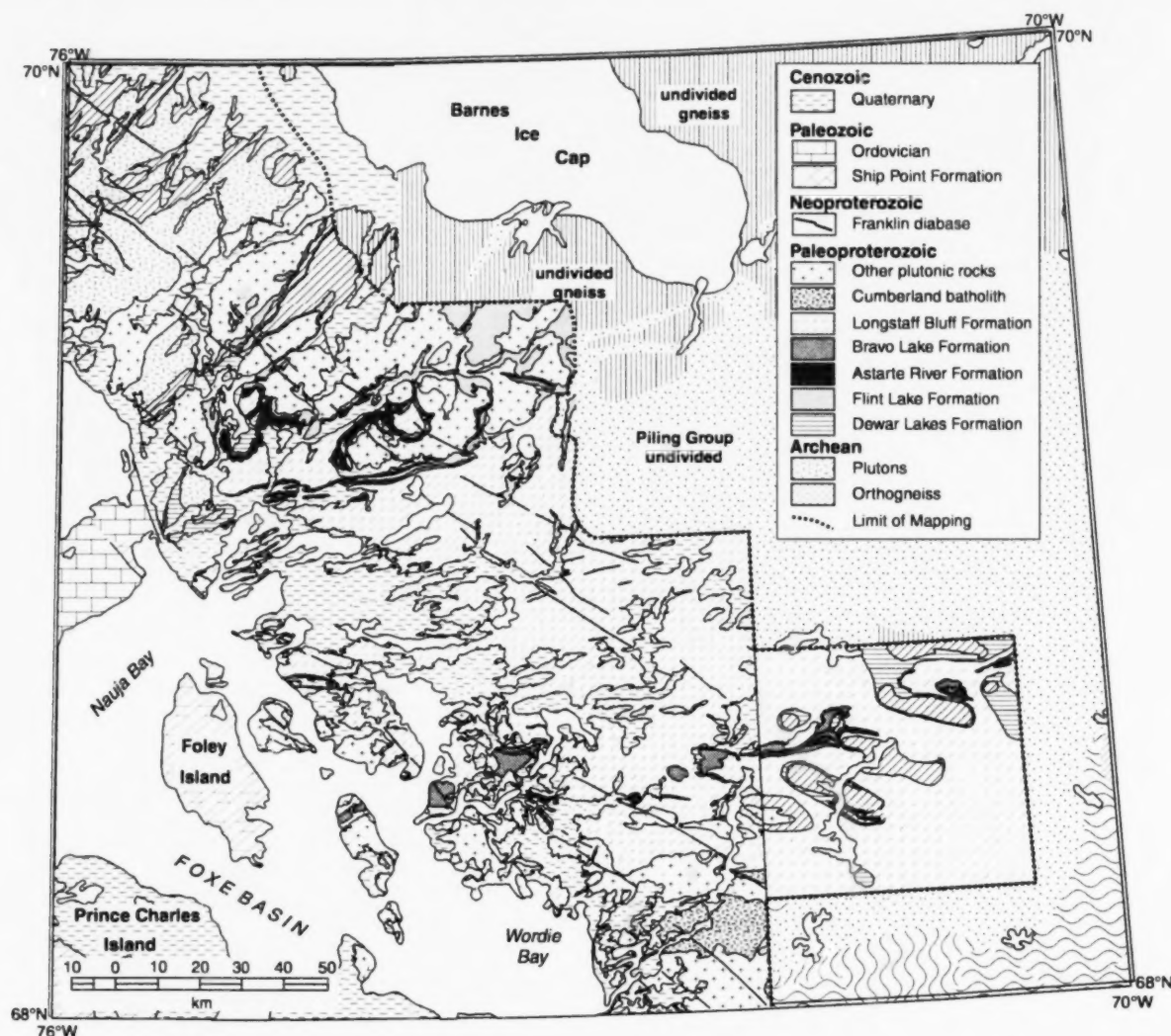


Figure 1. Simplified bedrock geological map of the Central Baffin Project area (modified after St-Onge et al., 2001a, b, c, d).

continental-margin succession (Morgan et al., 1975) originally deposited on the southern flank of the Archean Rae Craton and subsequently deformed during the Trans-Hudson Orogeny (see Corrigan et al., 2001, and references therein).

The lowest exposed structural levels of the crust in the project area are represented by Archean basement, exposed north of Flint Lake, and, as argued below, in domal structural culminations in the southern part of the map area (Fig. 1). Above this, Paleoproterozoic rocks of the Piling Group are preserved in a northeast-trending belt, the southern margin of which is intruded by the Cumberland batholith. As described below, the primary distribution of rock types within the Piling Group varies dramatically across the strike of the belt: carbonate strata are extensively exposed on the northern margin, whereas mafic volcanic rocks are exposed on the southern margin. Regional metamorphic grade increases outward from the central portion of the belt, from sub-greenschist facies to incipient granulite facies that is manifest by partially melting of Piling Group rocks (St-Onge et al., 2001a, b, c, d). In the following sections, the rocks are described from lowest to highest structural levels, based on the results of new 1:100 000 scale mapping on areas covered by NTS map sheets 37 C and 27 B (west half).

ORTHOGNEISS AND PLUTONIC ROCKS

In addition to continuous exposures north of Flint Lake (St-Onge et al., 2001a, b; Corrigan et al., 2001), a range of dominantly felsic gneiss and weakly deformed plutonic rocks outcrops in a series of structural domes (Tippett 1980, 1984; Henderson and Henderson, 1994) in the vicinity of Dewar Lakes (Fig. 1). The most abundant components within the gneiss range in composition from biotite $\pm$ hornblende granodiorite to monzogranite (Fig. 2); biotite $\pm$ hornblende tonalite layers are rare. Mafic layers are only locally present, and range in composition from hornblende $\pm$ biotite diorite to rare clinopyroxenite. Individual layers vary in thickness from several centimetres to several metres. Based on lithological and compositional similarities with gneissic rocks north of Flint Lake, which range from 2.85–2.71 Ga (Jackson et al., 1990; Bethune and Scammell, 1997), we concur with previous suggestions (Tippett 1984; Henderson and Henderson, 1994) that the gneiss exposed in the cores of the domes is also Archean. A representative suite of samples for U-Pb geochronology has been collected to test this correlation.

The gneissic layering is truncated in numerous localities by weakly to moderately foliated plutonic rocks that range in composition from biotite monzogranite to rare syenogranite. The age of these rocks is uncertain: some plutonic units with similar physical characteristics in the Flint Lake area have yielded late Archean ages, whereas others include rafts and xenoliths of Piling Group rocks and are therefore interpreted as Paleoproterozoic. Samples have been collected for U-Pb geochronology.

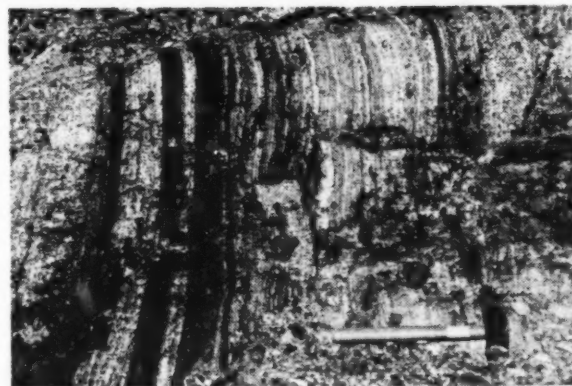


Figure 2. Layered (Archean?) orthogneiss, structural dome in the vicinity of Dewar Lakes. Hammer is 35 cm long.

The gneissic domes are mantled by quartzite and other supracrustal rocks of the Piling Group (Fig. 1). As described below, the contact is tectonic, indicating that the gneiss exposed in the domes represents a structural basement to the Paleoproterozoic rocks. Based on lithological and structural similarities, and pending the results of planned U-Pb geochronological investigations, we suggest that these culminations represent erosional windows that expose the southernmost, deformed edge of the Rae Craton.

PILING GROUP

Rocks of the Paleoproterozoic Piling Group are part of an extensive package (Jackson and Taylor, 1972) that is exposed as far west as the southern Melville Peninsula (Penrhyn Group; Henderson, 1983) and eastward to the coast of West Greenland (Karrat Group; Taylor, 1982). The informal stratigraphic nomenclature of the Piling Group was established by Morgan and co-workers (Morgan, 1983; Tippett, 1984). These units, and their relationships to one another, are described and illustrated (Fig. 3) in further detail below.

Dewar Lakes Formation

The stratigraphically lowest unit comprises white- to grey-weathering quartzite and feldspathic quartzite, locally interbedded with psammite and pelite. Bedding is tens of centimetres thick, grains range from fine sand to granules. Primary sedimentary structures, such as planar lamination and crossbedding (Fig. 4), have only rarely been observed. Sillimanite and muscovite are present in areas of highest metamorphic grade. The thickness of this unit is not accurately known; estimates derived from the width of exposures range from several hundreds of metres to in excess of 1 km across the map area. The extent to which these apparent thicknesses are affected by early isoclinal folding, or tectonic (thrust) repetition, is not well constrained.

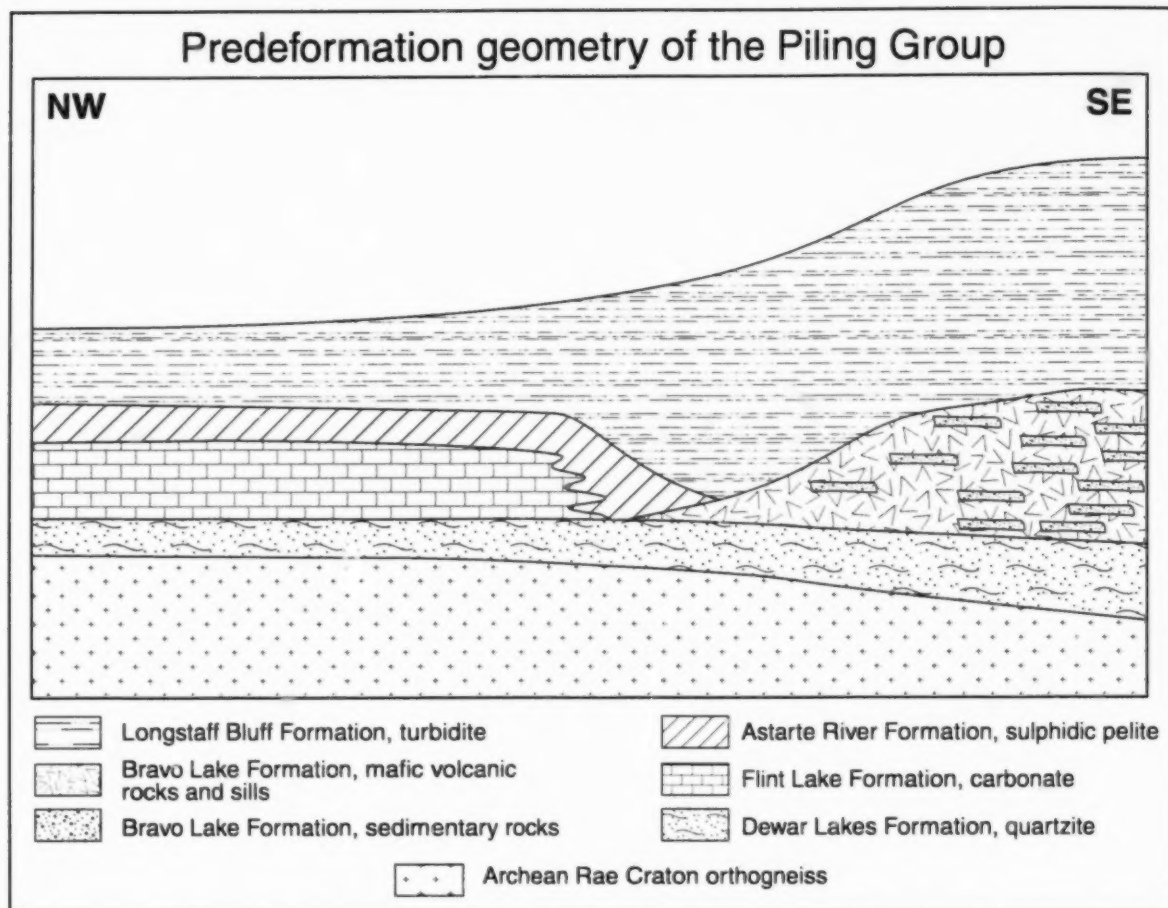


Figure 3. Schematic section of Piling Group and underlying Archean basement.

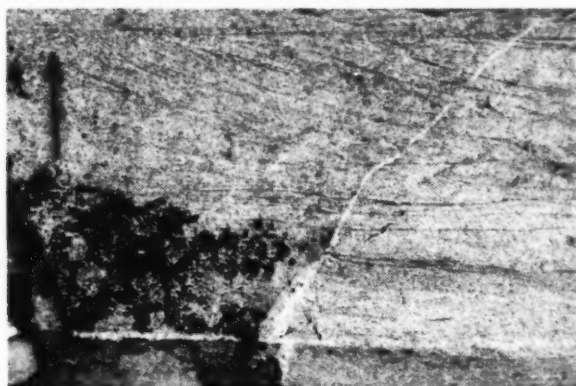


Figure 4. Crossbedding in quartzite, Dewar Lakes Formation. Pen is 15 cm long.

The uppermost part of the formation, approximately several hundreds of metres in thickness, is characterized by thinly bedded quartzite to psammite and rusty semipelite to pelite. The higher proportion of pelitic material in the uppermost parts of the formation, is consistent with a postulated deeper, more distal(?) depositional setting.

The basal contact with the underlying gneissic rocks is deformed at all observed localities (Fig. 5), such that it is not possible to unequivocally demonstrate a primary depositional relationship. The lowest exposed quartzite is typically strongly foliated, and commonly an intense mineral lineation is developed. The trend of these lineations ranges from 301° in the east, to 289° in the west. The underlying orthogneiss is also strongly recrystallized, with comparably oriented, planar fabrics developed parallel to those of the overlying quartzite, for distances of up to several tens to hundreds of metres structurally below the contact with the quartzite. Shear-sense indicators are rare, making it difficult to systematically document the sense of displacement throughout the map area.

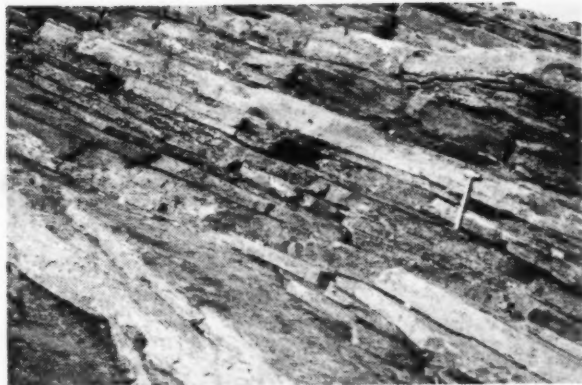


Figure 5. Basal contact of Dewar Lakes quartzite (upper right) with underlying (Archean?) orthogneiss (foreground). Hammer is 35 cm long.

Detrital zircons from a single sample of quartzite from this formation in the vicinity of Dewar Lakes have a bimodal age distribution: one population is 2.85 to 2.84 Ga, the other is 2.18 to 2.16 Ga (Henderson and Parrish, 1992). The Archean detritus is similar in age to known felsic plutonic rocks that form extensive parts of the Rae Craton, exposed to the north of the Piling Group (see Bethune and Scammell, 1997), suggesting that the adjacent craton may be the source of the older component of the detritus. This is consistent with the interpretation that these siliclastic rocks represent a passive-margin clastic sheet that was deposited on Rae basement. The younger grain population limits the depositional age of the entire Piling Group to younger than 2.16 Ga; the source of this detritus is enigmatic because extensive exposures of rocks of this age are not known in northeast Laurentia (cf. Scott and Gauthier, 1996; Scott et al., in press).

Flint Lake Formation

In the northern part of the project area (St-Onge et al., 2001a, b, c), white- to grey-weathering dolostone, marble, and calc-silicate units are interlayered with minor to rare siliciclastic material (Corrigan et al., 2001). These rocks are most extensively exposed north of Flint Lake (Fig. 1), where they overlie quartzite of the Dewar Lakes Formation (Corrigan et al., 2001). The base of the formation is placed at the lowest, decimetre-thick beds of carbonate material; a transitional interval, locally up to several tens of metres thick, comprises carbonate interbedded with siliciclastic material. The contact, where exposed, is generally parallel to the stratification in the underlying quartzite. Above the transition interval, carbonate beds range from centimetres to decimetres thick. Fine, subcentimetre laminations are only rarely preserved (Fig. 6), but are well developed in the area immediately northwest of Flint Lake. Metamorphic assemblages commonly include diopside, phlogopite, and humite, as well as rare spinel and olivine. A comprehensive overview of the petrology of the carbonate rocks is presented by Gagné (2001).



Figure 6. Finely laminated carbonate beds, Flint Lake Formation. Hammer is 30 cm long.

The maximum thickness of this formation is estimated to be 500 to 1000 m. The thickness of individual exposures, and the overall abundance of carbonate material decreases toward the south, such that only minor, thin exposures of carbonate material were noted in the 2001 study area (Fig. 1), typically as lenses several metres to tens of metres thick, in conformable contact with underlying Dewar Lakes quartzite. The rocks of the Flint Lake Formation are interpreted as a carbonate shelf succession; its spatial association with the southernmost exposures of the contiguous Rae basement in the northern parts of the project area is consistent with the interpretation of a south-facing continental margin.

Astarte River Formation

This formation is most extensively exposed northwest of Flint Lake (Fig. 1) where it comprises dark, rusty-weathering, graphitic pelite and semipelite and minor sulphide-facies iron-formation. Disseminated to locally massive seams of pyrite with minor pyrrhotite are common throughout this formation. Biotite and graphite characterize the assemblages in the lowest metamorphic grade rocks, whereas sillimanite and muscovite are present in highest grade exposures.

Although only rarely exposed, the contact with the underlying carbonate rocks of the Flint Lake Formation is sharp and parallel to the underlying layering. At the contact, an interval several metres thick comprises interbedded carbonate and pelite, passing upsection into monotonous, recessive-weathering pelite and semipelite. The maximum overall thickness of this formation is estimated from mapped exposures to be on the order of 500 m. The abrupt transition into pelitic rocks is interpreted as a response to foundering of the underlying carbonate shelf. The cause of this is unclear, but it may be related to changing tectonic conditions during the onset of mafic volcanism farther outboard in the basin.

Bravo Lake Formation

In the southern part of the project area (Fig. 1), mafic volcanic rocks and mafic and ultramafic sills are commonly interbedded with sedimentary rocks (Tippett, 1984). The base of the formation is placed below the mafic volcanic rocks that conformably overlie quartzite, psammite, and rusty semipelite of the Dewar Lakes Formation. The lowest grade metamorphic assemblages typically comprise actinolite $\pm$ epidote, whereas hornblende $\pm$ actinolite characterize the higher grade assemblages. The geochemistry of the mafic and ultramafic rocks of the Bravo Lake Formation is the subject of an ongoing Ph.D. project (S. Modeland, McGill University).

As described below, there appears to be a systematic variation in the nature and distribution of mafic and ultramafic rocks within the Bravo Lake Formation, with the overall abundance of these units increasing from east to west across the project area (Fig. 1). Whereas these mafic and ultramafic rocks and the carbonate rocks of the Flint Lake Formation both overlie siliciclastic rocks of the Dewar Lakes Formation, the stratigraphic relationship between the volcanic and carbonate rocks has not been observed.

'Ridges Lake'

In the eastern part of the project area (Locality 1, Fig. 1), massive mafic flows and breccias, as well as mafic and rare ultramafic sills are interbedded with quartzite, psammite, and, at higher stratigraphic levels, semipelite and rare calc-silicate rocks. Individual flows are typically several metres thick, and can be traced along-strike for tens to hundreds of metres. Coarsely crystalline sills are typically tens of metres thick and hundreds of metres long; the thickest sills are up to several hundred metres thick. Where sills are emplaced into semipelitic rocks in the upper part of the Bravo Lake Formation, extensive rusty, reddish-brown colour anomalies are widespread, disseminated sulphide mineralization (dominantly pyrite) is common, and thin seams of pyrite and minor pyrrhotite have been observed.

At several well exposed localities southwest of Ridges Lake (Locality 1, Fig. 1), the uppermost part of the Bravo Lake Formation is characterized by a several-metre-thick interval of thinly layered carbonate material interbedded with silicate- and oxide-facies iron-formation and minor mafic clastic material. This interval is reminiscent of the lowermost Astarte River Formation, north of Flint Lake. The overall thickness of the formation in the vicinity of Ridges Lake is estimated to be on the order of 2 km.

Nadlurjuq Lake

In the west-central part of the southern project area (Locality 2, Fig. 1), mafic flows and flow breccia are volumetrically dominant relative to sedimentary rocks. The stratigraphically lowest flows, together with thin mafic to ultramafic sills, lie above rusty semipelite and psammite, clastic rocks that are here interpreted as the uppermost part of the Dewar Lakes Formation. Upsection, several hundred metres of mafic flows

and sills, and subordinate cumulate-textured ultramafic sills, are present. Fragmental and massive mafic flows overlie the sills; rare pillowed flows indicate that the section is upright (Corrigan et al., 2001). The volcanic flows and breccias are locally intercalated with finely banded to massive calc-silicate material. The uppermost part of the formation is not exposed; the aggregate preserved thickness of the Bravo Lake Formation in the vicinity of Locality 2 is estimated to be approximately 800 to 1000 m.

'Pillow Island'

At the mouth of Straits Bay (Locality 3, Fig. 1), a number of very well exposed, low-lying islands exhibit a spectacular array of primary volcanic textures. The largest of these islands, informally named 'Pillow Island', is dominated by at least two distinct types of pillowed flows. The stratigraphically lower pillows have a pale green matrix and medium to coarse (<5 cm) phenocrysts of clinopyroxene. The overlying pillows are darker green with a mottled appearance that possibly mimics a relict primary (plagioclase?) porphyritic texture (Fig. 7). Several metres of ferruginous clastic sedimentary material are present near the top of the lower pillows.

Numerous populations of mafic to intermediate dykes feed and crosscut the pillowed flows. Fine- to medium-grained mafic dykes are aphyric, and intrude mottled and pale pillowed flows (Fig. 8). At one locality, at the northwest corner of the island, a clinopyroxene-phyric dyke appears to feed a cluster of clinopyroxene-phyric pillowed flows; on the southern side of the island, these dykes intrude the mottled pillows. A fine-grained dyke of intermediate composition (diorite?) intrudes the mottled pillows and aphyric dykes; a sample has been collected for U-Pb geochronology. The top of this unit is not observed.

Henderson and Henderson (1994) reported a U-Pb age of 1883.3 ± 4.7 Ma for a mafic sill in the vicinity of Dewar Lakes, northeast of Locality 1 on Figure 2. This sill has been

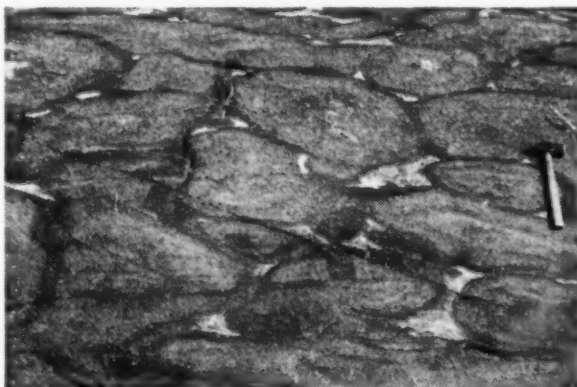


Figure 7. Mottled mafic pillowed flows, Bravo Lakes Formation on 'Pillow Island'. Hammer is 35 cm long.



Figure 8. Mafic dykes intruding mottled pillowed flows, Bravo Lakes Formation on 'Pillow Island'. Hammer is 35 cm long.



Figure 9. Psammite-pelite turbidites, Longstaff Bluff Formation. Stratigraphic tops to the right. Hammer is 35 cm long.

interpreted as part of the Bravo Lake magmatic event; if correct, all rocks of the Piling Group that overlie the Bravo Lake Formation are bracketed to younger than 1883 Ma. Alternatively, the dated sill may be part of a distinctly younger event, in which case the host sedimentary succession must be older than 1883 Ma. Additional samples for U-Pb geochronology were collected from several sills in the Bravo Lake Formation.

Longstaff Bluff Formation

The stratigraphically highest component of the Piling Group is a relatively homogeneous package of psammite, subordinate semipelite, and rare pelite. Bedding thickness ranges from 10 to 50 cm in the vicinity of Longstaff Bluff (Fig. 1), to 2 to 3 m in extreme cases in the central part of the map area. Graded bedding is commonly preserved in the thinner beds (Fig. 9); the majority of such observations indicate that the succession is upright (St-Onge et al., in press a, b, c). The regular nature of the fining-upward grain size distribution within individual beds, the extreme lateral continuity of individual beds (tens to hundreds of metres for decimetre-thick beds), and the overall homogeneity of the entire formation suggests that these deposits are turbidites.

In the centre of the belt, where metamorphic grade is subgreenschist, primary grain size is well preserved. The vast majority of the psammite beds comprise sand to coarse sand; granules are rare, and pebble conglomerate has been observed only as thin layers at the base of several coarser beds. Distinctive angular feldspar crystals and crystal fragments, conspicuously white in the otherwise grey psammite, have been noted in individual beds throughout the project area (Corrigan et al., 2001). Bedding-parallel calc-silicate pods, up to several tens of centimetres in diameter, are ubiquitous throughout the psammitic beds of this formation and interpreted as metamorphosed carbonate concretions.

The base of the Longstaff Bluff Formation is well exposed at numerous localities across the map area (Fig. 1). Southwest of Locality 1, psammite beds that contain hornblende and actinolite overlie mafic flows and also, where it is developed, the thin carbonate-iron-formation interval that locally characterizes the uppermost Bravo Lake Formation. The detrital mafic component of the psammites gradually diminishes upsection over several tens of metres; its presence is consistent with the interpretation that the psammitic rocks stratigraphically overlie the mafic units of the Bravo Lake Formation. In the northern part of the map area, in the vicinity of Flint Lake (Fig. 1), the lowermost psammite beds of the Longstaff Bluff Formation are interbedded with the distinctively rusty, graphitic pelites of the uppermost Astarte River Formation. This transitional interval occurs over less than 100 m, and gives way to the psammite-semipelite couplets that typify the Longstaff Bluff Formation.

The overall preserved thickness of the Longstaff Bluff Formation is estimated, based on structural sections drawn throughout the map area, to be between 3 and 5 km (F. Berniolles, pers. comm., 2001). In the absence of distinctive marker units within the formation, and in view of the extensive, tight to isoclinal folding that has occurred (described below), this estimate should be taken as a first-order approximation only. This turbidite succession blankets all underlying formations, and appears to signal a dramatic change in tectonic conditions in the basin. It could be a molasse derived from an orogenically uplifted area to the south, an interpretation that will be tested through geochemical, tracer isotopic, and geochronological investigations.

CUMBERLAND BATHOLITH

A suite of felsic plutonic rocks that ranges from rare tonalite, to granodiorite, dominant monzogranite, and minor syenogranite dominates the southern edge of the map area

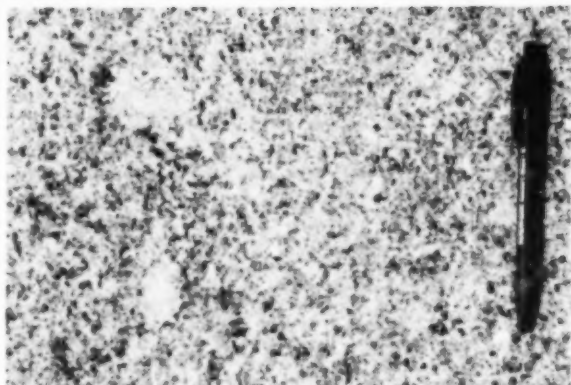


Figure 10. Potassium-feldspar megacrystic granite, Cumberland batholith. Pen is 15 cm long.

(Fig. 1; St-Onge et al., 2001d) and has been interpreted as the northern margin of the Cumberland batholith (Jackson and Taylor, 1972). Biotite and hornblende are ubiquitous accessory minerals; potassium feldspar megacrysts are common (Fig. 10), and locally characterize individual plutons. Toward the contact with supracrustal rocks of the Piling Group, garnet, and sillimanite become more common accessory phases. Rafts and xenoliths of identifiable Longstaff Bluff psammite are present in some of the northernmost plutons. Although no U-Pb age determinations have yet been made on rocks of the Cumberland batholith within the project area, work farther to the south has bracketed the overall age range as 1.87 to 1.84 Ga (Jackson et al., 1990; Scott, 1997; Scott and Wodicka, 1997).

In the vicinity of Flint Lake (Fig. 1), weakly to non-foliated, pink biotite monzogranite plutons intrude the lowermost part of the Piling Group. Similar rocks along-strike to the west in the area represented on the adjoining map sheet have been dated at 1.83 Ga (Bethune and Scammell, 1997). If this correlation is correct, these northern plutonic rocks may be unrelated to the Cumberland batholith. This interpretation will be tested with U-Pb geochronology.

FRANKLIN DIABASE DYKES

Fresh, undeformed diabase dykes of the northwest-trending, 723 ± 4/-2 Ma (Heaman et al, 1992) Franklin swarm are widespread across the map area. These vertical dykes range in width from several metres to hundreds of metres; the thickest dykes can be traced for tens of kilometres.

DEFORMATION AND METAMORPHISM

The late Archean tectonothermal history of the southern Rae Craton has been summarized by Bethune and Scammell (1997), based on work carried out immediately to the

northwest of the current map area. Overviews of the area north of Flint Lake have recently been presented (Corrigan et al., 2001; St-Onge et al., 2001a, b).

Evidence of the earliest Paleoproterozoic deformation in the map area (D_{1p}) is manifest as tight, intrafolial isoclinal folds of bedding in siliciclastic rocks of the Dewar Lakes Formation. Tectonic imbrication of the lowest formations of the Piling Group in the area north of Flint Lake (St-Onge et al., 2001b), and structural juxtaposition of rocks of the Bravo Lake Formation onto Longstaff Bluff turbidites in the southern part of the area (St-Onge et al., 2001c, d) are both interpreted to have occurred during D_{1p} .

Macroscopic, east-northeast-trending folds of Piling Group rocks and underlying basement units is ascribed to D_{2p} . These folds are typically plunge shallowly to the east-northeast, and vary from tight to open. The Flint Lake area (Fig. 1) is characterized by a series of relatively open syncline-anticline pairs. In contrast, the Longstaff Bluff turbidites that underlie much of the central part of the area comprise domains of either steep or shallowly dipping strata (St-Onge et al., 2001c), giving an overall stepped, south-dipping structural sequence. The basement-involved, thick-skinned D_{2p} folds are refolded (D_{3p}) by northwest- to northeast-trending upright cross folds that generate the resultant overall dome-and-basin geometry of the project area (Fig. 1). From the centre of the belt of Piling Group rocks (Fig. 1), mineral assemblages in pelitic rocks progress southward toward the Cumberland batholith from chlorite to biotite, biotite-muscovite, biotite-muscovite-cordierite-andalusite, K-feldspar-sillimanite-melt, and ultimately garnet-cordierite-K-feldspar-melt (Fig. 11). The volume of melt present in individual outcrops increases toward the batholith, from increasingly large pods through to dykes and sills (Fig. 12). Adjacent to the batholith, accumulations of locally generated melt material can be mapped as plutons of distinctive white, garnetiferous monzogranite (St-Onge et al., 2001d). The Cumberland batholith is regarded as the source of much of the heat required for this metamorphic zonation.

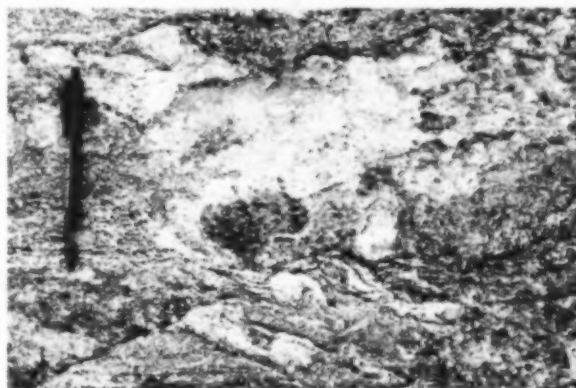


Figure 11. Garnet-cordierite-K-feldspar-melt assemblage in pelite of the Longstaff Bluff Formation. Pen is 15 cm long.

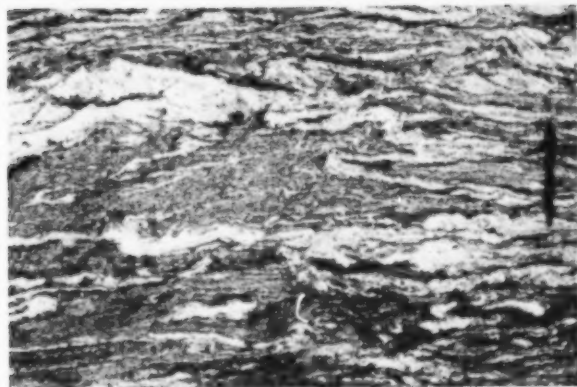


Figure 12. Dykes of white, garnetiferous monzogranite intruding psammite of the Longstaff Bluff Formation north of the Cumberland batholith. Pen is 15 cm long.

ECONOMIC GEOLOGY

The Paleoproterozoic rocks of the project area hold significant potential for a variety of mineral deposit types. In the north, relatively thick carbonate units (Flint Lake Formation) and overlying graphitic pelite (Astarte River Formation) have elevated potential to host Mississippi Valley type (MVT) and sedimentary-exhalative (SEDEX) base-metal deposits, respectively. In the south, the mafic and ultramafic rocks of the Bravo Lake Formation are exploration targets for Ni-Cu-PGE magmatic-sulphide deposits. The upper-amphibolite-facies siliciclastic rocks of the uppermost Dewar Lakes Formation may have potential for Broken Hill-type Pb-Zn-Ag deposits. In the northeastern part of the area, granitic pegmatites that are associated with lower part of the Longstaff Bluff Formation are potential hosts to Sn-Ta mineralization.

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